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Solubility Measurements and Modeling of Zinc, Lead and Iron Sulfides at High Temperatures and High Pressures

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Abstract

Solubility measurements of sulfides in aqueous solutions are necessary to understand the behaviour of these scaling minerals in geothermal and oil reservoirs. The low solubility levels of Zinc Sulfide (ZnS), Lead Sulfide (PbS) and Iron Sulfide (FeS) make the solubility measurements a challenging task. Consequently existing data are rare and scattered. The aim of this work is to develop a reliable experimental procedure and to measure solubility of sulfides at high temperature and pressures. Additionally the experimental data are used for estimation of the solid-liquid equilibrium using the Extended UNIQUAC model.

The experimental determination of the solubility of ZnS, PbS and FeS is carried out at temperatures up to 200°C and pressures up to 60 bars. The minerals in their pure form are added to ultra-pure water previously degassed with nitrogen. The aqueous solution is prepared in a reduced oxygen atmosphere to avoid the risk of oxidation of sulfide minerals. The solution is kept in an equilibrium cell at constant temperature and pressure with continuous stirring. The concentration of Zn^{2+}, Pb^{2+}, Fe^{2+} and S^{2-} are measured using Inductively Coupled Plasma Optical Emission spectrometry (ICP-OES) as analytical technique.

The solid-liquid equilibria is calculated using the Extended UNIQUAC model. The Extended UNIQUAC model is a local composition model and features several advantages compared to other models when describing the behaviour of aqueous electrolytes systems and it was presented by Thomsen and Rasmussen in 1999 [1]. The model accounts for the dependency of the solubility on pressure and temperature. The pressure parameters were proposed by Villafáfila *et al* (2005; 2006) [2] on their study on sulfate scaling minerals. The parameter estimation of the model is carried out based on the experimental data produced in our laboratory. The results show that the Extended UNIQUAC model can correlate the solubility data for sulfides within experimental accuracy.

References

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